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Sequential and parallel fodder production in wheat (*Triticum aestivum*)-based cropping system with special reference to nitrogen economy

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ABSTRACT

A field experiment was conducted during 1988–89 and 1989–90 for obtaining forage for animals and effecting nitrogen economy in wheat (*Triticum aestivum* L. emend. Fiori & Paol.)-based cropping system. Sorghum [*Sorghum bicolor* (L.) Moench] gave significantly higher green fodder (36.0 and 31.7 tonnes/ha), dry matter (10.1 and 10.4 tonnes/ha) and crude protein (930 and 684 kg/ha) compared with cowpea [*Vigna unguiculata* (L.) Walp.] in both years. However, cowpea gave significantly higher crude protein yield than sorghum in 1988. Wheat grown after cowpea gave significantly higher grain and straw yields than when grown after sorghum. In association with wheat, Egyptian clover (*Trifolium alexandrinum* L.) in border method (in every fourth skipped row) gave 7.7–7.9 tonnes/ha green fodder and 1.08–1.31 tonnes/ha dry matter without causing significant reduction in wheat yield.

The effect of nitrogen on wheat yield was significant and 120 kg N/ha gave significantly higher grain yield than 80 kg N/ha. There was a significant interaction between N levels to wheat crop and preceding forage crops in the rainy season. There was no significant difference in wheat yield due to 80 and 120 kg N/ha grown after cowpea, whereas after sorghum 120 kg N/ha recorded significantly higher grain yield than 80 kg N/ha. Therefore, growing of Egyption clover with wheat in every fourth skipped row sequence after cowpea found more productive and remunerative cropping system and economized fertilizer N up to 40 kg N/ha without adversely affecting the wheat yield.

There is hardly any scope to allocate land exclusively for the forage production, particularly with small farmers. Hence integration of leguminous forages as inter or mixed component with food crops seems to offer the best prospects for alleviating supply of high-quality animal feeds. This is possible through manipulation of plant density and spatial arrangements to accommodate food and fodder components concurrently (Miah, 1988; Singh *et al.*, 1988; Hosmani *et al.* 1986). Therefore, the present study was conducted to explore the possibility of growing forage legumes in association with wheat (*Triticum aestivum* L. emend. Fiori & Paol.).

MATERIALS AND METHODS

The field experiment was conducted during 1988–89 and 1989–90 at Jhansi. The soil was loam in texture, having organic carbon 0.49% and available nitrogen, phosphorus and potash 203.8, 12.3 and 472.2 kg/ha respectively.

The experiment was laid out in split-plot design with 4 replications. Twelve combinations of 2 preceding crops, viz. sorghum [*Sorghum bicolor* (L.) Moench] and cowpea [*Vigna ungiculata* (L.) Walp.], in rainy season and 6 methods of sowing of

wheat with and without Egyptian clover (*Trifolium alexandrinum* L.) and or lucerne (*Medicago sativa* L.) in different planting patterns formed the main plots, whereas N levels (80 and 120 kg N/ha) were taken in subplots. Sorghum ('PC 6') with 60 kg N + 50 kg P_2O_5 and 40 kg K_2O/ha, and cowpea ('NP 3') with 20 kg N + 60 kg P_2O_5/ha, were sown on 15 July and 20 July during the rainy season 1988 and 1989 respectively. Cowpea for fodder was harvested on 14 September 1988 and 23 September 1989, and sorghum on 13 October 1988 and 10 October 1989. Wheat ('Raj 1555') was sown on 16 November 1988 and 18 November 1989 with 60 kg P_2O_5 and 50 kg K_2O/ha and was harvested on 4 April 1989 and 31 March 1990. Six irrigations were given to wheat crop. Rainfall received during 1988–89 and 1989–90 was 540.2 and 501.6 mm respectively. Egyptian clover or lucerne was planted in additive series (with wheat rows of normal spacing of 22.5 cm) and in border method in replacement series (3 : 1). No additional fertilizer was provided to intercrop.

RESULTS AND DISCUSSION

The preceding crop of sorghum (Table 1) gave significantly higher green-forage yield and dry-matter yield than cowpea green and dry matter. However, crude-protein production by cowpea was significantly higher than that of sorghum during 1988, but

Table 1. Crop productivity of rainy-season (*kharif*) crops in wheat-based cropping system

Treatment	Fodder yield (tonnes/ha)						Crude protein yield (kg/ha)	
	Green fodder			Dry matter				
	1988	1989	Average	1988	1989	Average	1988	1989
Rainy-season crop								
Cowpea	31.0	20.4	25.7	5.2	3.6	4.4	930	614.0
Sorghum	36.2	31.8	34.0	10.1	10.4	10.3	750	682.1
CD (P = 0.05)	2.1	1.1		0.5	0.29		62	36.5
Methods of planting								
Pure wheat	32.5	27.2	29.8	7.5	7.1	7.3	811	680.7
Wheat (W) + Egyptian clover (E)†	35.2	25.7	30.5	8.0	6.8	7.4	889	634.9
W + lucerne (L)†	33.8	25.2	29.5	7.8	6.6	7.2	847	627.9
W 3 + S 1 (skipped)	33.3	27.1	30.3	7.6	7.0	7.3	814	680.7
W 3 + E 1‡	33.3	26.4	29.9	7.6	6.9	7.3	836	652.9
W 3 + L 1‡	33.4	24.9	29.2	7.7	6.5	7.1	834	611.2
CD (P = 0.05)	NS	NS	NS	NS	NS		37	NS
N level (kgha)								
80		26.2			6.80			653.4
120		25.9			6.78			642.7
CD (P = 0.05)		NS			NS			NS

†Forages in additive series
‡Forages in replacement series

Table 2. Crop productivity of winter (*rabi*) crops in wheat-based cropping system

Treatment	Wheat yield (tonnes/ha)				Egyptian clover or lucerne forage yield (tonnes/ha)				Crude-protein yield (kg/ha)	
	Grain		Straw		Green		Dry		1988–89	1989–90
	1988–89	1989–90	1988–89	1989–90	1988–89	1989–90	1988–89	1989–90		
Preceding crop										
Cowpea	4.81	4.55	6.79	5.74	7.05	6.79	0.92	1:02	195	207
Sorghum	3.32	3.74	4.60	4.92	11.50	9.61	1.88	1.53	357	322
CD (P = 0.05)	0.28	0.30	0.52	0.40	0.75	0.97	0.12	0.20	24	32
Methods of planting										
Pure wheat	4.39	4.43	5.78	5.84						
Wheat (W) + Egyptian clover (E)	3.59	3.97	5.21	5.13	15.05	13.42	2.44	2.02	443	391
W + lucerne (L) †	3.88	3.98	5.84	5.06	9.90	6.73	1.18	1.13	230	243
W 3 + S 1 (skipped) †	4.03	4.03	5.66	5.41						
W 3 + E 1 ‡	4.25	4.21	5.92	5.22	7.90	7.67	1.31	1.08	263	231
W 3 + L 1 ‡	4.24	4.25	5.77	5.35	4.30	4.98	0.68	0.87	167	192
CD (P = 0.05)	0.53	NS	NS	NS	1.0	0.80	0.24	0.29	360	460
N (kg/ha)										
80	3.85	3.88	5.39	5.09	9.55	8.59	1.52	1.02	298	277
120	4.27	4.41	6.00	5.57	10.05	7.81	1.32	1.53	253	252
CD (P = 0.05)	0.16	0.22	0.44	4.0	NS	0.57	0.08	0.20	36	20

W 3, Three rows of wheat; E, Egyptian clover; S, skipped; L, lucerne; † forages in additive with wheat rows of normal spacing of 23 cm; ‡ forages in replacement series

reverse was true during 1988.

During winter season wheat grown after cowpea gave significantly higher grain and straw yields than that obtained after sorghum in both the years (Table 2).

Maximum grain yield was recorded with regular planting of wheat during 1988–89 and 1989–90. Intercropping of Egyptian clover or lucerne in additive series or in border method (in every fourth skipped row) did not cause significant reduction in wheat yield except 1989–90 when Egyptian clover was intercropped in wheat (in additive series). Prakash *et al.* (1986) did not observe marked reduction in the yield of wheat due to intercropping with field pea and lentil and Singh and Yadav (1990) with gram or pea. The yield of wheat was not adversely affected by growing Egyptian clover or lucerne as an intercrop, because these are the leguminous dwarf-stature crops which are harvested frequently for forage. As such, these crops did not cause competition for plant nutrients and solar radiation, rather these crops helped the wheat crop by fixation of nitrogen. The decrease in grain and straw yields of wheat under intercropping of Egyptian clover in additive series was because of trampling effect on closely spaced wheat (22.5 cm) due to frequent cutting of Egyptian clover.

Application of 120 kg N/ha gave significantly higher grain and straw yields than 80 kg N/ha during both the years. Interaction effect between preceding rainy-season crops and nitrogen levels to wheat was significant. After cowpea, the grain yield of wheat with 120 and 80 kg N/ha was at par, however, after sorghum 120 kg N/ha gave significantly higher grain and straw yields of wheat than 80 kg N/ha. This was because of the fact that legume enriches the soil fertility. Singh and Singh (1991) also observed higher nitrogen requirement of wheat following pearl millet and sorghum than in sequence with leguminous crops. Malik *et al.* (1984) also reported similar results.

Egyptian clover recorded significantly highest green-forage and dry-matter yields than lucerne when it was grown in additive series, but it caused significant reduction in wheat yield during the first year.

In border method also Egyptian clover gave higher green-forage and dry-matter yields than lucerne, without adversely affecting the wheat yield. The protein production was also higher with Egyptian clover than with lucerne.

Though Egyptian clover with wheat in additive series gave 13.5–15.1 tonnes/ha green-forage yield, the technique suffers on account of practical feasibility.

Alternatively, growing of Egyptian clover in every fourth skipped row of wheat is practically feasible and provides reasonably acceptable bonus yield of Egyptian clover (7.5–8.0 tonnes/ha) without causing significant reduction in grain yield of wheat.

REFERENCES

Hosmani, S. A., Hansal, C. S. and Rangaswamy, K. T. 1986. Intercropping of fodder legumes in sorghum in the transitional belt of North Karnataka. *Journal of Farming Systems* **2** (3–4) : 4–9.

Malik, A. S., Singh, Kanwar and Narwal, S. S. 1984. Effect of preceding crops with and without P on nitrogen requirement of succeeding wheat. *Journal of Research, Haryana Agricultural University, Hisar* **14** (2) : 192–9.

Miah, M. N. 1988. 'Intercropping of selected food and forage legumes after wetland rice.' Ph. D. Dissertation, University of Philippines, Los Banos, Laguna, Philippines, pp. 220.

Prakash, Ved, Tandon, J. P. and Kamata Prasad. 1986. Studies on intercropping in rainfed wheat. *Annals of Agricultural Research* **7** (2) : 258–262.

Singh, Janardan and Yadav, D. S. 1990. Studies on wheat based intercropping systems under rainfed conditions. *Indian Journal of Agronomy* **35** (3) : 262–265.

Singh, Kanwar and Singh, Surinder. 1991. Different wheat (*Triticum aestivum*)-based cropping systems, and their fertilizer requirement, yield and economic return. *Indian Journal Of Agricultural Sciences* **61** (10) : 709–714.

Singh, R. P., Kaushik, M. K. and Sharma, K. C. 1988. Studies on maize legume intercropping systems under tarai conditions. *Indian Journal of Agronomy* **33** (4) : 385–388.